Original Research Article

Effect of Plant Growth Regulators at different levels of Zinc on Growth and Yield of Groundnut (*Arachis hypogea* L.)

Abstract

The field experiment entitled **"Effect of Plant Growth Regulator at different levels of Zinc on growth and yield of Groundnut *(Arachis hypogea* L.)"** was conducted during *kharif* season of 2021 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The experiment plot was sandy loam in texture, nearly acidic in soil reaction (P^H 6.9), low in organic carbon (0.112%), available N (278.93Kg/ha), available P(10.8Kg/ha) and available K (206.4Kg/ha).The experiment was laid out in Randomized Block Design, treatments of different plant growth regulator levels (75, 100 and 125 ppm) and zinc levels *viz*.(20,25 and 30 kg/ha) were imparted in the experiment and were replicated thrice.

The experiment was laid out in Randomized Block Design comprised of 3 replications and total 9 treatments viz. T_1: (GA3)75PPM + 20 kg/ha $ZnSO_4$, T_2: (GA_3) 75PPM + 25 kg/ha $ZnSO_4$, T_3: (GA_3) 75PPM+ 30 kg/ha $ZnSO_4$, T_4:(GA_3) 100PPM + 20 kg/ha $ZnSO_4$, T_5: (GA_3) 100PPM +25 kg/ha $ZnSO_4$, T_6: (GA_3) 100PPM + 30 kg/ha$ZnSO_4$, T_7: (GA_3) 125PPM + 20 kg/ha $ZnSO_4$, T_8: (GA_3) 125PPM + 25 kg/ha ZnSO4, T_9: (GA_3) 125PPM +30 kg/ha $ZnSO_4$. Results obtained indicated that there was significant increase in growth parameters at harvest *viz*., plant height (58.40cm), number of nodules/plant (59.77), dry weight accumulation(38.1g),and yield attributes viz., No.pods/plant(19.3), No.kernals/pod (4.3), seed index(44.50), seed yield (3169 kg/ha), Haulm yield (4747.3kg/ha) were recorded with the application of (GA3125ppm+ ZnSO4 30kg/ha). However, Maximum Gross return (142636.5 INR/ha), Net return (102971.1INR/ha) and B:C ratio (2.59) was recorded with the application of (GA3125ppm+ ZnSO4 30kg/ha). Therefore, it is concluded that the application of (GA3125ppm+ZnSO430kg/ha) was more productive and economically feasible.

Keywords: Groundnut, Plant Growth Regulator (GA_3), Zinc, Economics.

INTRODUCTION

Groundnut (*Arachis hypogea* L.) is one of the commercial crops of the world that rank 13th among the food crops grown over an area of 5.40 million ha and production of 5.43 million tonnes with a productivity of 910kg/ha (AICRP 2020). About two third of the world's groundnut production is used as oil and remaining one third is consumed as food. Being the best source of vegetable oil, it also provides raw material for industrial serving as concentrated animal feed on organic manure. It contributed to sustainable agriculture being a legume and cultivated since long in both kharif and summer season by the agriculturist. Groundnut contains on an average 12-15 percent carbohydrate, 25-30 percent protein and 45-50 percent oil. The high-energy value protein content and minerals make groundnut a rich source of nutrition at a comparatively low price.

Among plant growth regulators, Gibberellin play a vital role in regulating developmental processes within plant bodies. Gibberellin helps in cell growth of stem, leaves and other aerial parts b causing cell elongation, and increase in intermodal length. A higher concentration of gibberellins increases plant growth **(Bora and Sarma 2006).** The different concentrations of GA had significant effect on growth in mustard **(Akter *et al.* 2007).** GA_3 is an important growth regulator that may have many uses to modify the growth, yield and yield attributing characters of plant **.** Plant growth regulators are used widely to improve plant performance. GA_3 is one of those growth regulators that have positive effect on plant as enhancing vegetative growth and plant yield and increasing dry weight **(Islam *et al*., 2007).** GA_3has been widely used to improve germination rate, seedling growth and consequently yield. **Yakubu *et al.*, (2013), Rastogi *et al.*, (2013).**

In India, zinc is now considered as the fourth most important yield limiting nutrient after nitrogen, phosphorus and potassium, respectively. Among oilseeds, groundnut in particular suffers from Zn deficiency **(Singh, 2007).** Zinc deficiency start yellowing of leaves from lamina to base, mid-rib and veins remain green, later on necrotic brown spots are developed and dorsal leaf veins become brown. It is likely to occur when soils are low in organic matter and alkaline under high levels of soil p and soils are cool and wet during the vegetative phase, zinc increases the chlorophyll content in the leaves and nodule number, pod production and weight. Zinc's function in cell membrane integrity will also be discussed especially for root cells along with its role in suppressing free radical damage to cells **(Cakmak, 2000).** Zinc increases the resistance of plants to pathogens by bringing changes in anatomy and physiology of host plant.

MATERIALS AND METHODS:-

The experiment was carried out during *Kharif* season of 2021 at the CRF (Crop Research Farm) SHIATS, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The crop Research Farm is situated at 25.75^0 N latitude, 87.19^0 E longitude and at an altitude of 98m above mean sea level. This area is situated on the right side of the river Yamuna and by the opposite side of Prayagraj City. All the facilities required for crop cultivation were available. .The experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.9), low in organic carbon (0.112%), available N (278.93 Kg/ha), available P (10.8 Kg/ha) and available K (206.4 Kg/ha). The crop was sown on 20^{th} july 2020 using variety Shekhar. The experiment was laid out in Randomized Block Design comprised of 3 replications and total 9 treatments viz. T_1: (GA3) 75PPM + 20 kg/ha $ZnSO_4$, T_2: (GA_3) 75PPM + 25 kg/ha $ZnSO_4$, T_3: (GA_3) 75PPM+ 30 kg/ha $ZnSO_4$, T_4: (GA_3) 100PPM + 20 kg/ha $ZnSO_4$, T_5: (GA_3) 100PPM +25 kg/ha $ZnSO_4$, T_6: (GA_3) 100PPM + 30 kg/ha $ZnSO_4$, T_7: (GA_3) 125PPM + 20 kg/ha $ZnSO_4$, T_8: (GA_3) 125PPM + 25 kg/ha ZnSO4, T_9: (GA_3) 125PPM + 30 kg/ha $ZnSO_4$. All nutrients were applied into the soil in the form of Urea, Single super phosphate (SSP) and Muriate of potash (MOP). Entire dose of P and K was applied basal for respective plots, half dose of N (as urea) was applied as basal, one-fourth at 30 days after sowing and remaining one-fourth at the time of flowering. Zinc levels are (20,25,30 kg/ha) was applied as soil application along with NPK fertilizers before sowing .Plant growth regulator levels are (75,100,125 ppm) was applied as foliar spray through Knapsack sprayer as two doses. One at 22 DAS and another one at 45DAS. The growth parameters were recorded at periodical intervals of 15,30,45,60,75 DAS and at harvest stage from the randomly selected five plants in each treatment. Statistically analysis was done for all the parameters in one way Anova and mean compared at 5% probability level of significant results.

RESULTS AND DISCUSSION

Effect of Plant Growth Regulator at different levels of Zinc on growth parameters of Groundnut

Effect of Plant Growth Regulator and Zinc on growth parameters of Groundnut of are presented in Table1. In the results revealed that maximum plant height (58.40cm), number of nodules/plant(59.77), dry weight(38.1),was observed with application of (GA_3) 125PPM + 30Kg/ha $ZnSO_4$ where crop growth rate(10.00) and relative growth rate(0.009) was observed with application of(GA_3) 125PPM + 30Kg/ha $ZnSO_4$ as closely followed by the Plant height(56.86), number of nodules/plant(58.40), Dry matter accumulation(37.3) which was recorded in the treatment of ((GA_3) 125PPM + 25Kg/ha $ZnSO_4$). Maximum plant height and maximum number of nodules are obtained due to the corresponding increase in level of GA_3 at all the growth stages and the function of zinc is to produce chlorophyll to the plant, electron transportation, enzyme activation and Zinc can help in the nodulation activity due to enzymatic activity and nitrogen fixation which ultimately increase nodulation. Higher dry matter accumulation depends upon the photosynthesis and respiration rate, which finally increases the plant growth with respect to increased plant height, number of nodules etc. The favourable effect of plant growth regulator and zinc might influence the metabolism of the plant, effect on photosynthetic pigments and activity of enzymes which in turn helps to increase in the vegetative growth. The results on higher crop growth was also reported by **A Akter *et al.*, (2007) , Reddi Naveen kumar *et al*., (2021).**

Effect of Plant Growth Regulator at different levels of Zinc on yield parameters of Groundnut

Effect of Plant Growth Regulator at different levels of Zinc on yield parameters of Groundnut are presented in Table2. In the results revealed that higher No. pods/ plant (19.3), No. kernels/ pod(4.3), Seed index (44.50), Seed yield (3169.7 kg/ha) and Haulm yield (4747.3 kg/ha) was recorded with application of (GA_3)

125PPM + 30Kg/ha $ZnSO_4$ and Harvest Index (41.6) was observed with application of (GA_3) 125PPM + 25Kg/ha $ZnSO_4$ as closely followed by the No. pods/ plant(18.8), No. kernels/ pod(3.9), Seed index (41.40), Seed yield (2923.6kg/ha) was observed with the application of (GA_3) 125PPM + 25Kg/ha $ZnSO_4$). The favourable combination of GA3 and zinc plays a vital role in increasing seed yield because they both takes place in many physiological processes like increasing the chlorophyll content, carbohydrate metabolism, protein synthesis, regulating the stomata, cell elongation, pod formation, increasing the flowering set which enhance the seed yield. The yield of a crop is the cumulative effect of yield attributing characters such as pods per plant, kernels per pod and seed index. Thus, the seed yield of ground nut also increased significantly due to application of zinc as a consequence of highest values of above parameters. The increase in seed yield due to zinc and GA_3 application might be due to the cumulative effect of increased plant height, number of nodules per plant and dry matter production i.e., increased growth parameters. The seed and haulm yields combined together showed significant increase in biological yield of ground nut. The results of the present investigation are in close conformity with the findings of **Sai Surya Goutami V. and Ananda N (2018)**

Effect of Plant Growth Regulator at different levels of Zinc on economics

Effect of Plant Growth Regulator at different levels of Zinc on economics of Groundnut presented in Table 3. The highest gross returns (142636.5INR/ha), higher net returns (102971.1INR/ha) and maximum B:C ratio (2.59) recorded with the application of (GA_3) 125PPM + 30Kg/ha $ZnSO_4$ This was mainly due to higher seed and haulm yields compared to other treatment combinations. Gross returns, net returns and B: C ratio increased significantly due to successive increase in varying levels of PGR and Zinc with application of ($GA_3$75ppm +$ZnSO_4$ 30Kg/ha). This might be attributed to higher seed and haulm yields obtained with comparatively less cost than additional income under these treatments. Similarly results were also reported by **Chittam Ravi Kishore Reddy et al.,(2019)**

Table 1. Effect of Plant Growth Regulator at different levels of zinc on growth parameters at harvest of groundnut

Treatments	Plant height (cm)	No.of nodules/plant	Plant dry weight (g/plant)	Crop growth rate ($g/m^2/day$)	Relative growth rate (g/g/day)
1. (GA_3) 75PPM + 20 Kg/ha $ZnSO_4$	52.46	46.99	34.1	10.00	0.009
2 (GA_3) 75PPM + 25 Kg/ha $ZnSO_4$	53.40	48.77	34.8	7.41	0.006
3.(GA_3) 75PPM + 30 Kg/ha $ZnSO_4$	54.86	50.77	35.7	7.90	0.006
4. (GA_3) 100PPM + 20 Kg/ha $ZnSO_4$	54.53	49.55	35.1	7.53	0.006
5. (GA_3) 100PPM + 25 Kg/ha $ZnSO_4$	54.93	51.66	35.9	7.66	0.006
6. (GA_3) 100PPM + 30 Kg/ha $ZnSO_4$	55.86	53.99	36.6	7.29	0.005
7. (GA_3) 125PPM + 20Kg/ha $ZnSO_4$	55.93	52.55	36.2	7.41	0.005
8. (GA_3) 125PPM + 25Kg/ha $ZnSO_4$	56.86	58.40	37.3	6.91	0.005
9. (GA_3) 125PPM + 30Kg/ha $ZnSO_4$	58.40	59.77	38.1	7.16	0.005
F test	S	S	S	NS	NS
SEm (±)	0.62	0.63	0.33	0.95	0.0009
CD (5%)	1.88	1.09	0.99	-	-

Table 2. Effect of Plant Growth Regulator at different levels of zinc on yield parameters of groundnut

Treatments	No.of pods/plant	No.of kernels/pod	Seed index (g)	Seed yield (kg/ha)	Haulm yield (kg/ha)	Harvest index (%)
1. (GA_3) 75PPM + 20 Kg/ha $ZnSO_4$	15.5	2.7	39.40	2460.7	3788.7	38.6
2 (GA_3) 75PPM + 25 Kg/ha $ZnSO_4$	17.3	3.2	39.51	2536.9	3985.3	38.9
3. (GA_3) 75PPM + 30 Kg/ha $ZnSO_4$	17.8	3.6	40.23	2463.8	4145.3	37.5
4. (GA_3) 100PPM + 20 Kg/ha $ZnSO_4$	17.4	3.3	39.93	2547.3	3640.3	41.2
5. (GA_3) 100PPM + 25 Kg/ha $ZnSO_4$	18.3	3.6	40.37	2633.4	3749.0	41.3
6. (GA_3) 100PPM + 30 Kg/ha $ZnSO_4$	18.6	4.0	41.10	2673.6	4526.7	37.9
7. (GA_3) 125PPM + 20Kg/ha $ZnSO_4$	18.5	3.8	40.93	2774.0	4378.0	38.8
8. (GA_3) 125PPM + 25Kg/ha $ZnSO_4$	18.8	3.9	41.40	2923.6	4098.7	41.6
9. (GA_3) 125PPM + 30Kg/ha $ZnSO_4$	19.3	4.3	44.50	3169.7	4747.3	40.0
F test	S	S	S	S	S	S
SEm (±)	0.22	0.14	1.08	13.06	130.36	0.73
CD (5%)	0.66	0.42	0.42	39.15	390.83	2.19

Table 3. Effect of Plant Growth Regulator at different levels of zinc on Economics of groundnut

S. No	Treatments	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1	(GA_3) 75PPM + 20Kg/ha $ZnSO_4$	38790.4	110731.5	71941.1	1.85
2	(GA_3) 75PPM + 25Kg/ha $ZnSO_4$	38915.4	114160.5	75245.1	1.93
3	(GA_3) 75PPM + 30Kg/ha $ZnSO_4$	39165.4	110871.0	71705.6	1.83
4	(GA_3) 100PPM + 20Kg/ha $ZnSO_4$	38990.4	114628.5	75638.1	1.94
5	(GA_3) 100PPM + 25Kg/ha $ZnSO_4$	39115.4	118503.0	79387.6	2.02
6	(GA_3) 100PPM + 30Kg/ha $ZnSO_4$	39369.4	120312.0	80946.6	2.05
7	(GA_3) 125PPM + 20Kg/ha $ZnSO_4$	39290.4	124830.0	85539.6	2.17
8	(GA_3) 125PPM + 25Kg/ha $ZnSO_4$	39415.4	131562.0	92146.6	2.33
9	(GA_3) 125PPM + 30Kg/ha $ZnSO_4$	39665.4	142636.5	102971.1	2.59

conclusion

It may be concluded that application of (GA_3) 125PPM + 30Kg/ha $ZnSO_4$ showed higher yield and economics. Therefore, it is recommended for farmers for receiving higher yield and economic benefits of Groundnut

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